Appendix A

Emission Factor Derivations

The following physical constants and standard conditions were utilized to derive the criteria-pollutant emission factors used to calculate criteria pollutant and toxic air contaminant emissions.

standard temperature[a]:	70^oF
standard pressure[a]:	14.7 psia
molar volume:	385.3 dscf/lbmol
ambient oxygen concentration:	20.95%
dry flue gas factor[b]:	8600 dscf/MM BTU
natural gas higher heating value:	1030 BTU/dscf

[a]BAAQMD standard conditions per Regulation 1, Section 228.

[b]F-factor is based upon the assumption of complete stoichiometric combustion of natural gas. In effect, it is assumed that all excess air present before combustion is emitted in the exhaust gas stream. Value shown reflects the typical composition and heat content of utility-grade natural gas in San Francisco bay area.

Table A-1 summarizes the regulated air pollutant emission factors that were used to calculate mass emission rates for each source. All units are pounds per million BTU of natural gas fired based upon the high heating value (HHV). All emission factors reflect abatement by applicable control equipment.

Table A-1
Controlled Regulated Air Pollutant Emission Factors for Gas Turbines and HRSGs

Pollutant	Source					
	Gas Turbine			Gas Turbine & HRSG		
	lb/MM BTU	lb/hr @ 17^oF	lb/hr @ 62^oF	lb/MM BTU	lb/hr @ 17^oF	lb/hr @ 62^oF
Nitrogen Oxides (as NO_2)	0.00731[a]	13.71	12.84	0.00731[a]	15.67	14.76
Carbon Monoxide	0.0088[b]	16.5	15.46	0.0088[b]	18.9	17.77
Precursor Organic Compounds	0.00126	2.36	2.2	0.00206	4.42	4.25
Particulate Matter (PM_{10})	0.0048	9	9	0.00594	12.75	12.75
Sulfur Dioxide	0.00092	1.75	1.62	0.00092	2	1.86
Sulfuric Acid Mist (H_2SO_4)	0.00107	2	1.88	0.00107	2.82	2.16

[a]based upon the permit condition stack gas emission limit of 2.0 ppmvd NO_x @ 15% O_2 that reflects the use of dry low-NO_x combustors at the CTG, low-NO_x burners at the HRSG, and abatement by Selective Catalytic Reduction Systems with ammonia injection

[b]based upon the permit condition stack gas emission limit of 4 ppmvd CO @ 15% O_2 that reflects the use of oxidation catalysts

REGULATED AIR POLLUTANTS

NITROGEN OXIDE EMISSION FACTORS

Gas Turbine and Heat Recovery Steam Generator Combined

The combined NO_x emissions (as NO_2) from the GT and HRSG will be limited to 2.0 ppmv, dry @ 15% O_2. This emission limit will also apply when the HRSG duct burners are in operation. This concentration is converted to a mass emission factor as follows:

(2.0 ppmvd)(20.95 - 0)/(20.95 - 15) = 7.04 ppmv NO_x, dry @ 0% O_2

($7.04/10^6$)(1 lbmol/385.3 dscf)(46.01 lb NO_2/lbmol)(8600 dscf/MM BTU)

= 0.00723 lb NO_2/MM BTU

The NO_2 mass emission rate based upon the maximum firing rate of the gas turbine alone @ 17^{o}F is calculated as follows:

(0.00723 lb/MM BTU)(1,875.5 MM BTU/hr) = **13.56 lb NO_2/hr**

The applicant calculated a slightly higher mass emission rate of **13.71 lb NO_2/hr**.

This converts to an emission factor of:

(13.71 lb/hr)/(1875.5 MM BTU/hr) = **0.00731 lb NO_2/MM BTU**

The NO_2 mass emission rate when duct burner firing occurs is based upon the maximum combined firing rate of the gas turbine and HRSG is:

(0.00723 lb/MM BTU)(2,147.7 MM BTU/hr) = **15.53 lb NO_2/hr**

The applicant calculated a slightly higher mass emission rate of **15.67 lb NO_2/hr**.

The annual average NO_2 mass emission rate based upon the maximum firing rate of the gas turbine alone at the annual average temperature of 62^{o}F is:

(0.00731 lb/MM BTU)(1,756.7 MM BTU/hr) = **12.84 lb NO_2/hr**

The annual average NO_2 mass emission rate when duct burner firing occurs is based upon the maximum combined firing rate of 2,018.9 MM BTU/hr and is:

(0.00731 lb/MM BTU)(2,018.9 MM BTU/hr) = **14.76 lb NO_2/hr**

CARBON MONOXIDE EMISSION FACTORS

Gas Turbine and Heat Recovery Steam Generator Combined

The combined CO emissions from the GT and HRSG duct burner will be limited by permit condition to a maximum controlled CO emission concentration of 4 ppmv, dry @ 15% O_2 during all operating modes except gas turbine start-up and shutdown. The emission factor corresponding to this emission concentration is calculated as follows:

(4 ppmv)(20.95 - 0)/(20.95 - 15) = 14.08 ppmv, dry @ 0% O_2

$(14.08/10^6)$(lbmol/385.3 dscf)(28 lb CO/lbmol)(8600 dscf/MM BTU)

= **0.0088 lb CO/MM BTU**

The CO mass emission rate based upon the maximum firing rate of the gas turbine alone is calculated as follows:

(0.0088 lb/MM BTU)(1,875.5 MM BTU/hr) = **16.5 lb CO/hr**

The CO mass emission rate when duct burner firing occurs is based upon the maximum combined firing rate of each gas turbine and HRSG and is calculated as follows:

(0.0088 lb/MM BTU)(2,147.7 MM BTU/hr) = **18.9 lb CO/hr**

The annual average CO mass emission rate based upon the maximum firing rate of the gas turbine alone at the annual average temperature of 62^{o}F (1,756.7 MM BTU/hr) is calculated as follows:

(0.0088 lb/MM BTU)(1,756.7 MM BTU/hr) = **15.46 lb CO/hr**

The annual average CO mass emission rate when duct burner firing occurs is based upon the maximum combined firing rate of each gas turbine and HRSG and is calculated as follows:

(0.0088 lb/MM BTU)(2,018.9 MM BTU/hr) = **17.77 lb CO/hr**

PRECURSOR ORGANIC COMPOUND (POC) EMISSION FACTORS

Gas Turbine

Midway Power estimates a maximum POC (non-methane, non-ethane hydrocarbon) stack gas emission concentration of 1 ppmv @ 15% O_2 for full load operation of the gas turbine alone. The emission factor corresponding to this emission concentration is calculated as follows:

(1 ppmv)(20.95 - 0)/(20.95 - 15) = 3.52 ppmv, dry @ 0% O_2

$(3.52/10^6)$(lb-mol/385.3 dscf)(16 lb CH_4/lb-mol)(8600 dscf/MM BTU)

= **0.00126 lb POC/MM BTU**

The POC mass emission rate based upon the maximum firing rate @ 17^{o}F is:

POC = (0.00126 lb/MM BTU)(1,875.5 MM BTU/hr) = **2.36 lb/hr**

The applicant has calculated a slightly lower POC emission rate of **2.24 lb/hr**.

The POC mass emission rate based upon the maximum firing rate @ 62^{o}F is:

POC = (0.00126 lb/MM BTU)(1,756.7 MM BTU/hr) = **2.2 lb/hr**

The applicant has calculated a slightly lower POC emission rate of **2.1 lb/hr**.

Gas Turbine and Heat Recovery Steam Generator Combined

Midway Power estimates a maximum POC (non-methane, non-ethane hydrocarbon) stack gas emission concentration of 1.64 ppmv @ 15% O_2 for full load operation of the gas turbine with duct burner firing and steam injection power augmentation.

The emission factor corresponding to this emission concentration is calculated as follows:

(1.64 ppmv)(20.95 - 0)/(20.95 - 15) = 5.77 ppmv, dry @ 0% O_2

($5.77/10^6$)(lb-mol/385.3 dscf)(16 lb CH_4/lb-mol)(8600 dscf/MM BTU) = **0.00206 lb POC/MM BTU**

The POC mass emission rate based upon the maximum firing rate @ 17^{o}F is:

POC = (0.00206 lb/MM BTU)(2,147.7 MM BTU/hr) = **4.42 lb/hr**

The applicant has calculated a slightly lower POC emission rate of **4.25 lb/hr**.

The POC mass emission rate based upon the maximum firing rate @ 62^{o}F is:

POC = (0.00206 lb/MM BTU)(2,018.9 MM BTU/hr) = **4.16 lb/hr**

The applicant has calculated a slightly lower POC emission rate of **4 lb/hr**.

PARTICULATE MATTER (PM_{10}) EMISSION FACTORS

Gas Turbine

Based upon vendor specifications, Midway Power has proposed a maximum PM_{10} emission rate of 9 lb/hr at maximum load for each gas turbine.

The corresponding PM_{10} emission factor is therefore:

(9 lb PM_{10}/hr)/(1,875.5 MM BTU/hr) = **0.0048 lb PM_{10}/MM BTU**

The following stack data will be used to calculate the grain loading at standard conditions for full load gas turbine operation without duct burner firing to determine compliance with BAAQMD Regulation 6-310.3.

The following worst-case stack gas characteristics (with respect to grain loading) during full load operation w/o duct burner firing occur at the lowest expected typical ambient temperature of 45^{o}F.

PM_{10} mass emission rate:	9 lb/hr
exhaust gas flow rate:	887,080 acfm @ 13.42% O_2 and 189^{o}F
moisture content:	8.78% by volume

Converting flow rate to standard conditions:

(887,080 acfm)(70 + 460 ^{o}R/189 + 460 ^{o}R)(1 – 0.0878) = 660,821 dscfm

Converting to grains/dscf:

(9 lb PM_{10}/hr)(1 hr/60 min)(7000 gr/lb)/(660,821 dscfm) = 0.0016 gr/dscf

Converting to 6% O_2 basis:

(0.0016 gr/dscf)[(20.95 - 6)/(20.95 – 13.42)] = 0.0032 gr/dscf @ 6% O_2

Gas Turbine and HRSG Combined

Midway Power has estimated a maximum PM_{10} emission rate of 12.75 lb/hr at the maximum combined firing rate of 2,147.7 MM BTU/hr during duct burner firing based upon vendor specifications and assumptions regarding the formation of sulfate particulates.

The corresponding PM_{10} emission factor is therefore:

(12.75 lb PM_{10}/hr)/(2,147.7 MM BTU/hr) = **0.00594 lb PM_{10}/MM BTU**

The following stack data will be used to calculate the grain loading for full load turbine operation with duct burner firing at standard conditions to determine compliance with BAAQMD Regulation 6-310.3.

The following worst-case stack gas characteristics (with respect to grain loading) during full load with duct burner firing occur at the highest expected "typical" ambient temperature of 98°F.

PM_{10} mass emission rate:	12.75 lb/hr
typical flow rate:	979,879 acfm @ 9.88% O_2 and 155°F
typical moisture content:	11.95% by volume

Converting flow rate to standard conditions:

(911,489 acfm)(70 + 460 °R/155 + 460 °R)(1 - 0.1195) = 892,119 dscfm

Converting to grains/dscf:

(12.75 lb PM_{10}/hr)(1 hr/60 min)(7000 gr/lb)/(892,119 dscfm) = 0.0015 gr/dscf

Converting to 6% O_2 basis:

(0.0015 gr/dscf)[(20.95 - 6)/(20.95 – 11.95)] = 0.0025 gr/dscf @ 6% O_2

SULFUR DIOXIDE EMISSION FACTORS

Gas Turbine & Heat Recovery Steam Generator

The SO_2 emission factor is based upon an expected maximum natural gas sulfur content of 3300 gr/10^6 scf of natural gas and a higher heating value of 1022 BTU/scf.

The sulfur emission factor is calculated as follows:

(3300 gr/10^6 scf)(2 lb SO_2/lb S)(scf/1022 BTU)(1 lb/7000 gr)(10^6 BTU/MM BTU)

= **0.00092 lb SO_2/MM BTU**

This is converted to an emission concentration as follows:

(0.00092 lb SO_2/MM BTU)(385.3 dscf/lb-mol)(lb-mol/64.06 lb SO_2)(10^6 BTU/8600 dscf)

= 0.64 ppmvd SO_2 @ 0% O_2
which is equivalent to:

(0.64 ppmvd)(20.95 - 15)/20.95 = 0.18 ppmv SO_2, dry @ 15% O_2

The SO_2 mass emission rate for the gas turbine with duct burner firing at 17°F is:

(0.00092 lb SO_2/MM BTU)(2,147.7 MM BTU/hr) = **2 lb/hr**

The SO_2 mass emission rate for the gas turbine alone at 17°F is:

(0.00092 lb SO_2/MM BTU)(1,875.5 MM BTU/hr) = **1.75 lb/hr**

The SO_2 mass emission rate for the gas turbine with duct burner firing at 62°F is:

(0.00092 lb SO_2/MM BTU)(2,018.9 MM BTU/hr) = **1.86 lb/hr**

The SO_2 mass emission rate for the gas turbine alone at 62°F is:

(0.00092 lb SO_2/MM BTU)(1,756.7 MM BTU/hr) = **1.62 lb/hr**

SULFURIC ACID MIST EMISSION FACTORS

Gas Turbine & Heat Recovery Steam Generator

The H_2SO_4 emission factor is based upon an expected maximum natural gas sulfur content of 2500 gr/10^6 scf of natural gas and a higher heating value of 1022 BTU/scf. To be conservative, it is assumed that all of the sulfur contained in the fuel is converted to sulfuric acid mist.

(2500 gr/10^6 scf)(98 lb H_2SO_4/32 lb S)(scf/1022 BTU)(1 lb/7000 gr)(10^6 BTU/MM BTU)

= **0.00107 lb SO_2/MM BTU**

The H_2SO_4 mass emission rate for the gas turbine with duct burner firing at 17°F is:

(0.00107 lb SO_2/MM BTU)(2,147.7 MM BTU/hr) = **2.3 lb/hr**

The H_2SO_4 mass emission rate for the gas turbine alone at 17°F is:

(0.00107 lb SO_2/MM BTU)(1,875.5 MM BTU/hr) = **2 lb/hr**

The H_2SO_4 mass emission rate for the gas turbine with duct burner firing at 62°F is:

(0.00107 lb SO_2/MM BTU)(2,018.9 MM BTU/hr) = **1.86 lb/hr**

The H_2SO_4 mass emission rate for the gas turbine alone at 62°F is:

(0.00107 lb SO_2/MM BTU)(1,756.7 MM BTU/hr) = **1.62 lb/hr**

Toxic Air Contaminants

The following toxic air contaminant emission factors were used to calculate worst-case emissions rates used for air pollutant dispersion models that estimate the resulting increased health risk to the maximally exposed population. To ensure that the risk is properly assessed, the emission factors are conservative and may overestimate actual emissions.

Table A-2
TAC Emission Factors[a] for Gas Turbines and HRSG Duct Burners

Contaminant	Emission Factor (lb/MM scf)
Acetaldehyde[c]	1.37E-01
Acrolein	1.89E-02
Ammonia[b]	6.75
Benzene[c]	1.33E-02
1,3-Butadiene[c]	1.27E-04
Ethylbenzene	1.79E-02
Formaldehyde[c]	9.17E-01
Hexane	2.59E-01
Naphthalene	1.66E-03
Propylene	7.71E-01
Propylene Oxide[c]	4.78E-02
Toluene	7.10E-02
Xylene	2.61E-02
Total PAHs	1.06E-04

[a]California Air Toxics Emission Factors (CATEF) Database as compiled by California Air Resources Board under the Air Toxics Hotspot Program; mean values

[b]based upon maximum allowable ammonia slip of 5 ppmv, dry @ 15% O_2 for A-2, A-4, A-6, and A-8 SCR Systems

[c]carcinogenic compound

Table A-3 TAC Emission Factors for Each 11-Cell Cooling Tower

Toxic Air Contaminant	Maximum Concentration in Cooling Tower Return Water (ppmw)	Emission Factor[a] (lb/hr)
Arsenic[b]	0.04	1.48E-05
Bromide	4.2	1.56E-03
Cadmium[b]	0.08	2.96E-05
Trivalent chromium	0.05	1.85E-05
Copper	0.1	3.70E-05
Fluoride	1.8	6.67E-04
Mercury	0.016	5.93E-06
Nickel	0.04	1.48E-05
Manganese	0.14	5.19E-05
Sulfate	860	3.19E-01
Zinc	0.18	6.66E-05

[a]based upon maximum drift rate of 0.0005% and operation of cooling tower at maximum water circulation rate of 148,110 gallons per minute; for example:

Arsenic $= (0.04/10^6)(0.000005)(148,110 \text{ gal/min})(60 \text{ min/hr})(8.337 \text{ lb/gal})$
$= 1.48\text{E-}05 \text{ lb/hr}$

[b]carcinogenic compound

AMMONIA SLIP EMISSION FACTORS

Combustion Gas Turbine & Heat Recovery Steam Generator

Each Gas Turbine/HRSG power train will exhaust through a common stack and be subject to an ammonia slip limit of 5 ppmvd @ 15% O_2.

NH_3 emission concentration limit:	5 ppmvd @ 15% O_2
Typical dry gas flow rate (w/duct burner):	898,057 acfm, dry @ 12.62% O_2 by volume
Maximum dry gas flow rate (w/duct burner):	973,165 acfm, dry @ 12.76% O_2 by volume

Correcting ammonia concentration to actual oxygen content at full load with duct burner firing:

(5 ppmvd)(20.95 – 12.76)/(20.95 – 15) = 6.88 ppmvd @ 12.76% O_2

The maximum ammonia mass emission rate at full load with duct burner firing is therefore:

(6.88 ppmvd/10^6)(973,165 dscfm)(60 min/hr)(lb-mol/471.1 dscf)(17 lb NH_3/lb-mol)

= 14.5 lb NH_3/hr

Based upon the maximum combined heat input for a gas turbine/HRSG of 2,147.7 MM BTU/hr @ 17^{o}F, this mass emission rate converts to the following emission factor:

(14.5 lb NH_3/hr)/(2,147.7 MM BTU/hr) = **0.00675 lb NH_3/MM BTU**
= **6.75 lb NH_3/MM scf**

Correcting ammonia concentration to actual oxygen content at full load with duct burner firing under typical operating conditions:

(5 ppmvd)(20.95 – 12.62)/(20.95 – 15) = 7 ppmvd @ 12.62% O_2

The ammonia mass emission rate at full load without duct burner firing is therefore:

(7 ppmvd/10^6)(898,057 dscfm)(60 min/hr)(lb-mol/471.1 acf)(17 lb NH_3/lbmol)

= 13.6 lb NH_3/hr

Based upon the maximum heat input for a gas turbine of 2,018.9 MM BTU/hr @ 62^{o}F, this mass emission rate converts to the following emission factor:

(13.6 lb NH_3/hr)/(2,018.9 MM BTU/hr) = **0.00675 lb NH_3/MM BTU**
= **6.75 lb NH_3/MM scf**

Table A-4
Regulated Air Pollutant Emission Factors for
Fire Pump Diesel Engine

Pollutant	Emission Factor	
	g/bhp-hr	lb/hr[b]
Nitrogen Oxides (as NO_2)	6.9[a]	5.6
Carbon Monoxide	2.75[a]	2.23
Precursor Organic Compounds	1.5[a]	1.2
Particulate Matter (PM_{10})	0.15[a]	0.12
Sulfur Dioxide	0.93	0.75

[a]per District BACT Guideline 96.1.2

[b]based upon maximum rated output of 368 bhp

Table A-5
Toxic Air Contaminant Emission Factors for
Fire Pump Diesel Engine

Toxic Air Contaminant	Emission Factor[a] (lb/MM BTU)
Benzene	9.33E-04
Toluene	4.09E-04
Xylenes	2.85E-04
Propylene	2.58E-03
1,3-Butadiene	3.91E-05
Formaldehyde	1.18E-03
Acetaldehyde	7.67E-04
Acrolein	9.25E-05
Total PAHs	1.68E-04
Diesel Particulate	0.16 g/bhp-hr

[a]AP-42 Table 3.3-2, “Speciated Organic Compound Emission Factors for Uncontrolled Diesel Engines”

Appendix B

Emission Calculations

Individual and combined heat input rate limits for the Gas turbines, HRSGs, and auxiliary boilers are given below in **Table B-1**. These are the basis of permit conditions limiting heat input rates.

Table B-1 Maximum Allowable Heat Input Rates

Source	MM BTU/ hour-source		MM BTU/ day-source	MM BTU/ year-source
	@ 17°F	@ 62°F		
S-1, S-3, S-5, and S-7 Gas Turbines	1,875.5	1,756.7	45,190.4[a]	5,126,929[b]
S-1 CTG and S-2 HRSG (combined) S-3 CTG and S-4 HRSG (combined) S-5 CTG and S-6 HRSG (combined) S-7 CTG and S-8 HRSG (combined)	2,147.7[c]	2,018.9[c]	51,544.8[d]	10,619,414[e]
Turbines and HRSGs combined	8,590.8	8,075.6	206,417.6[f]	62,985,372

[a]based upon 24 hour per day operation without duct burner firing @ 17°F

[b]based upon 2,800 hours of operation at full load, without duct burner firing @ 62°F

[c]maximum combined firing rate for each gas turbine and corresponding HRSG duct burner

[d]based upon maximum duct burner firing of 24 hours per day @ 17°F

[e]based upon maximum annual duct burner firing of 5,260 hr/year-HRSG @ 62°F; calculated as:

(5,260 hr/yr)(2,018.9 MM BTU/hr) = 10,619,414 MM BTU/year

[f]based upon 24 hr/day duct burner firing for all four power trains @17°F

B-1.0 Gas Turbine Start-Up and Shutdown Emission Rate Estimates

The maximum nitrogen oxide, carbon monoxide, and precursor organic compound mass emission rates from a gas turbine occur during start-up periods. The PM_{10} and sulfur dioxide emissions are a function only of fuel use rate and do not exceed typical full load emission rates during start-up. The NO_x, CO, and UHC (POC) emission rates shown in Table B-3 are Midway Power estimates and are based upon gas turbine vendor estimates.

Table B-2
Gas Turbine Start-Up Emission Rates
(lb/start-up)

Pollutant	Cold Start-Up[a]		Hot Start-Up[b]		Warm Start-Up[c]	
	lb/hr	lb/start-up	lb/hr	lb/start-up	lb/hr	lb/start-up
NO_x (as NO_2)	150	415.5	109.5	116.2	131.5	225.8
CO	400	901.5	350	355.9	662.5	1180.25
UHC (as CH_4)	32	83	35	35.3	45	79
PM_{10}[d]	12.75	63.75	12.75	19.1	12.75	38.25
SO_x (as SO_2)[e]	2	10	2	3	2	6

[a]cold start not to exceed five hours; by definition, occurs after turbine has been inoperative for at least 48 hours

[b]hot start not to exceed 90 minutes; by definition, occurs within 8 hours of a shutdown

[c]warm start not to exceed 3 hours; by definition occurs between 8 and 48 hours of a shutdown

[d]as a conservative estimate, based upon full load emission factor of 0.0058 lb PM_{10}/MM BTU and maximum heat input rate of 1,875.5 MM BTU/hr

[e]based upon full load emission factor of 0.0007 lb SO_2/MM BTU and maximum heat input rate of 1,875.5 MM BTU/hr

After considering source test data of the Los Medanos Energy Center gas turbines, it is assumed that turbine shutdown emission rates for NO_x, CO, and POC do not exceed full load emission rates. **Table B-3** is a comparison of baseload emission rates and shutdown emission rates based upon source test data. Although shutdown emission rates may exceed maximum hourly emission rates during baseload operation, the annual emissions are not underestimated since turbine downtime is not counted. That is, annual emission estimates assume that each turbine operates for a total of 8,060 hours per year, excluding start-up and shutdown time.

Table B-3 Gas Turbine Shutdown Emission Rates

Pollutant	Baseload Emission Rate (lb/hr)[a]	Los Medanos Energy Center Source Test Results[b]	
		lb/hr	lb/shutdown
NO_x (as NO_2)	15.67	39.5	16.86
CO	18.9	11.9	5.75
UHC (as CH_4)	4.42	5.2	5.2

[a]TPP emission rates for gas turbine w/duct burner firing

[b] highest of two G.E. Frame 7F turbines; testing dates July, August 2002

B-2.0 Operating Scenarios and Regulated Air Pollutant Emissions for Gas Turbines and HRSGs

The Gas Turbine/HRSG air pollutant emission rates (except for NO_x) shown in **Table B-4** are the basis of permit condition limits and emission offset requirements and were also used as inputs for the ambient air quality impact analysis. To provide maximum operational flexibility, no limitations will be imposed on the type or quantity of turbine start-ups. Instead, the facility must comply with rolling consecutive twelve month mass emission limits at all times. The mass emission limits are based upon the emission estimates calculated for the following power plant operating envelope.

- 2,800 hours of baseload (100% load) operation per year for each gas turbine
- 5,260 hours of duct burner firing per HRSG per year with steam injection power augmentation at gas turbine combustors
- 27 hot start-ups per gas turbine per year (90 minutes/start-up)
- 9 warm start-ups per gas turbine per year (180 minutes/start-up)
- 12 cold start-ups per gas turbine per year (300 minutes/start-up)

Table B-4 Maximum Annual Regulated Air Pollutant Emissions for Gas Turbines and HRSGs

Source (Operating Mode)	NO_2 (lb/yr)	CO (lb/yr)	POC (lb/yr)	PM_{10} (lb/yr)	SO_2 (lb/yr)	H_2SO_4 (lb/yr)
S-1, S-3, S-5, & S-7 Gas Turbines (108 total 1.5-hr hot start-ups)	12,549.6	38,437.2	3,812.4	2,062.8	324	324
S-1, S-3, S-5, & S-7 Gas Turbines (36 total 3-hr warm start-ups)	8,128.8	42,489	2,844	1,377	216	216
S-1, S-3, S-5, & S-7 Gas Turbines (48 total 5-hr cold start-ups)	19,944	43,272	4,464	3,060	480	480
S-1, S-3, S-5, & S-7 Gas Turbines (11,200 total hours @ 1,756.7 MM BTU/hr; 62°F)	143,808	173,152	24,640	100,800	18,144	21,056
S-1 Gas Turbine & S-2 HRSG S-3 Gas Turbine & S-4 HRSG S-5 Gas Turbine & S-6 HRSG S-7 Gas Turbine & S-8 HRSG (21,040 total hours w/duct burner firing @ 2,018.9 MM BTU/hr; 62°F)	310,550.4	373,880.8	89,420	268,260	39,134.4	45,446.4
Total Emissions (lb/yr)	494,880.8	671,231	125,180.4	375,559.8	58,298.4	67,522.4
(ton/yr)	**247.440**	**335.616**	**62.590**	**187.780**	**29.149**[a]	**33.761**[a]

[a]represents worst-case emission rates assuming that all fuel-bound sulfur is converted to the compound indicated; it is not physically possible for the emission rates of each compound to reach these levels simultaneously

B-3.0 Fire Pump Diesel Engine Emissions

Table B-5 Regulated Air Pollutant Emissions for Fire Pump Diesel Engine

Pollutant	Emission Factor		Annual Emissions[a]	
	g/bhp-hr	lb/hr	lb/yr	ton/yr
Nitrogen Oxides (as NO_2)	6.9	5.6	280	0.140
Carbon Monoxide	2.75	2.23	111.5	0.056
Precursor Organic Compounds	1.5	1.2	60	0.030
Particulate Matter (PM_{10})	0.15	0.12	6.1	0.003
Sulfur Dioxide	0.93	0.75	37.5	0.019

[a]based upon 50 hours of operation per year for testing and maintenance and maximum rated output of 368 bhp

Table B-6 Worst-Case Toxic Air Contaminant Emissions for Fire Pump Diesel Engine

Toxic Air Contaminant	Emission Factor (lb/MM BTU)	Annual Emissions[a] (lb/yr)
Benzene	9.33E-04	0.124
Toluene	4.09E-04	0.054
Xylenes	2.85E-04	0.04
Propylene	2.58E-03	0.34
1,3-Butadiene	3.91E-05	0.005
Formaldehyde	1.18E-03	0.16
Acetaldehyde	7.67E-04	0.1
Acrolein	9.25E-05	0.01
Total PAHs	1.68E-04	0.02
Diesel particulate	0.13 lb/hr	6.5

[a]based upon assumed maximum fuel use rate of 19 gal/hr (2.66 MM BTU/hr) and maximum 50 operating hours per year

B-4.0 Cooling Tower PM_{10} Emissions

Cooling tower circulation rate: 148,110 gpm
maximum total dissolved solids: 6000 ppmw
Drift Rate: 0.0005 %

Water mass flow rate: (148,110 gal/min)(60 min/hr)(8.34 lb/gal) = 74,114,244 lb/hr
Cooling Tower Drift: (74,114,244 lb/hr)(0.000005) = 370.57 lb/hr

PM_{10} = (6000 ppmw)(370.57 lb/hr)/(10^6)(0.313)
= 0.7 lb/hr-tower
= 16.8 lb/day-tower (24 hr/day operation)
= 6,132 lb/yr-tower (8,760 operating hours per year)
= **3.066 ton/yr-tower**

PM_{10} emission rate per cell:

(6,132 lb/yr-tower)(tower/11 cells)(yr/8760 hr) = 0.0636 lb/hr-cell
= **0.008 g/s-cell**

B-5.0 Worst-Case Toxic Air Contaminant (TAC) Emissions

The maximum toxic air contaminant emissions resulting from the combustion of natural gas at the S-1, S-3, S-5, & S-7 Gas Turbines and S-2, S-4, S-6, & S-8 HRSGs are summarized in **Table B-7**. These emission rates were used as input data for the health risk assessment modeling and are based upon a maximum annual heat input rate of 14,165,796 MM BTU per year (13,753.2 MM scf/yr based upon a fuel HHV of 1030 BTU/scf) for each gas turbine/HRSG power train. The derivation of the emission factors is detailed in Appendix A.

Table B-7
Worst-Case Annual TAC Emissions for Gas Turbines and HRSGs

Toxic Air Contaminant	Emission Factor[a] (lb/MM scf)	lb/yr-power train[b]	g/sec
Acetaldehyde[c]	1.37E-01	1,884.2	2.71E-02
Acrolein	1.89E-02	260	3.74E-03
Ammonia[d]	6.75	92,834.1	1.34
Benzene[c]	1.33E-02	183	2.63E-03
1,3-Butadiene[c]	1.27E-04	1.75	2.51E-05
Ethylbenzene	1.79E-02	246	3.54E-03
Formaldehyde[c]	9.17E-01	12,611.7	1.82E-01
Hexane	2.59E-01	3,562	5.12E-02
Naphthalene	1.66E-03	22.8	3.28E-04
Propylene	7.71E-01	10,603.7	1.53E-01
Propylene Oxide[c]	4.78E-02	657.4	9.45E-03
Toluene	7.10E-02	976.5	1.40E-02
Xylenes	2.61E-02	359	5.16E-03
Total PAHs	1.06E-04	1.46	2.10E-05

[a]CARB CATEF II Database emission factors, mean values

[b]from each gas turbine/HRSG power train (S-1 & S-2, S-3 & S-4, S-5 & S-6, and S-7 & S-8); based upon annual gas usage rate of 13,753.2 MM scf/yr-turbine/HRSG

[c]carcinogenic compounds

[d]based upon the worst-case ammonia slip from the SCR system of 5 ppmvd @ 15% O_2

The projected toxic air contaminant emissions from each exempt 11-cell cooling tower are summarized in **Table B-8**. The emissions are based upon an water circulation rate of 148,111 gpm and 8,760 hours of operation per year.

Table B-8 Worst-Case TAC Emissions for Each 11-Cell Cooling Tower

Toxic Air Contaminant	Emission Factor (lb/hr)	Annual Emission Rate (lb/yr)	(lb/yr-cell)	Risk Screening Trigger Level (lb/yr)
Arsenic	1.48E-05	0.13	1.18E-02	0.025
Bromide	1.56E-03	1.4	1.27E-01	330
Cadmium	2.96E-05	0.26	2.36E-02	0.046
Trivalent chromium	1.85E-05	0.16	1.45E-02	None specified
Copper	3.70E-05	0.32	2.91E-02	460
Fluoride	6.67E-04	5.84	0.53	None specified
Mercury	5.93E-06	0.052	4.73E-03	58
Nickel	1.48E-05	0.13	1.18E-02	0.73
Manganese	5.19E-05	0.45	4.09E-02	77
Sulfate	3.19E-01	2,790	254	None specified
Zinc	6.66E-05	0.58	5.27E-02	6,800

B-6.0 Maximum Facility Emissions

The maximum annual facility regulated air pollutant emissions for the proposed gas turbines and HRSGs are shown in **Table B-9**. The total permitted emission rates shown below are the basis of permit condition limits and emission offset requirements, if applicable.

Table B-9 Maximum Annual Facility Regulated Air Pollutant Emissions (ton/yr)

Source	NO_2	CO	POC	PM_{10}	SO_2	H_2SO_4
S-1 CTG and S-2 HRSG[a]	61.860	83.904	15.648	46.950	7.287	8.440
S-3 CTG and S-4 HRSG[a]	61.860	83.904	15.648	46.950	7.287	8.440
S-5 CTG and S-6 HRSG[a]	61.860	83.904	15.648	46.950	7.287	8.440
S-7 CTG and S-8 HRSG[a]	61.860	83.904	15.648	46.950	7.287	8.440
Sub-Total	**247.440**	**335.616**	**62.590**	**187.780**	**29.149[a]**	**33.761[a]**
11-Cell Cooling Towers	0	0	0	6.132	0	0
S-9 Diesel Fire Pump Engine	0.140	0.056	0.030	0.003	0.019	0
Total Facility Emissions	**247.580**	**335.672**	**62.620**	**194.015**	**29.168**	**33.761**

[a]includes gas turbine start-up and shutdown emissions

Table B-10
Baseload Air Pollutant Emission Rates for Gas Turbines and HRSGs
(Excluding Gas Turbine Start-up and Shutdown Emissions)

	NO_2	CO	POC	PM_{10}	SO_2
Each Gas Turbine (1875.5 MM BTU/hr @17°F)					
lb/hr-source	13.71	16.5	2.36	9	1.75
lb/day-source	329	396	56.6	216	42
Each Gas Turbine/HRSG Power Train (2,147.7 MM BTU/hr @ 17°F and 24 hour per day duct burner firing					
lb/hr-power train	15.67	18.9	4.42	12.75	2
lb/day-power train	376	453.6	106.1	306	48

The maximum daily regulated air pollutant emissions per source including gas turbine start-up emissions are shown in **Table B-11**.

Table B-11 Maximum Daily Regulated Air Pollutant Emissions per Power Train (lb/day)

Source (operating mode)	NO_2	CO	POC	PM_{10}	SO_2
Gas Turbine (5-hr cold start-up)	415.5	901.5	83	63.75	10
Gas Turbine & HRSG (19 hours full load w/duct burner firing @ 17°F)	297.7	359.1	84	242.25	38
Total	**713.2**	**1,260.6**	**167**	**306**	**48**

Table B-12 summarizes the worst-case daily regulated air pollutant emissions from permitted sources. These are the basis of permit condition daily mass emission limits. The operating scenario assumes simultaneous cold start-up of two gas turbines followed by 19 hours of full load operation with duct burner firing. The other two gas turbines start-up after a one hour delay to insure that the PSD impact modeling analysis for 1-hr standards is preserved. Fire pump diesel engine operates for a maximum of 0.5 hours per day for exercising.

Table B-12 Worst-Case Daily Regulated Air Pollutant Facility Emissions from Permitted Sources (lb/day)

Source (Operating Mode)	NO_2	CO	POC	PM_{10}	SO_2
Two Gas Turbines (5-hr cold start-up)	831	1802.9	165.9	127.5	20
Two Gas Turbine/HRSG Power Trains (19 hours @ full load w/Duct Burner Firing @ 17^{o}F)	595.5	718.2	168	484.5	76
Two Gas Turbines (5-hr cold start-up)	831	1802.9	165.9	127.5	20
Two Gas Turbine/HRSG Power Trains (18 hours @ full load w/Duct Burner Firing @ 17^{o}F)	564.1	680.4	159.1	459	72
Gas Turbine/HRSG Powertrain Sub-total	**2,821.6**	**5,004.4**	**658.9**	**1,198.5 (1,224)[a]**	**188 (192)[a]**
S-9 Diesel Fire Pump Engine	2.8	1.1	0.6	0.07	0.38
Total	**2,824.4**	**5,005.5**	**659.5**	**1,224.07**	**192.4**

[a]daily maximum for these pollutants occur when all four turbines are operating at full load w/duct burner firing @ 17^{o}F for 24 hours

B-7.0 Modeling Emission Rates

Tables B-13 through B-19 show the emission rates that were used to model the air quality impacts of the TPP to determine compliance with applicable State and Federal ambient air quality standards for the pollutants indicated. A screening impact analysis of gas turbine/HRSG duct burner emission rates and stack gas characteristics showed that the worst-case annual average impacts occur under the equipment operating scenarios shown in each table.

Table B-13
NO_2 Emission Rates for Worst-Case Annual-Average Impacts

Source (Operating Mode)	NO_2		
	lb/yr	lb/hr	g/s
Gas Turbine (27 hot start-ups/turbine)	3,137.4		
Gas Turbine (9 warm start-ups/turbine)	2,032.3		
Gas Turbine (12 cold start-ups/turbine)	4,986		
Gas Turbine (2,800 firing hours/turbine @ 1,756.7 MM BTU/hr)	35,952		
Gas Turbine and associated HRSG (5,260 hours/turbine w/duct burner firing @ 2,018.9 MM BTU/hr)	77,637.6		
Total Emissions for each Gas Turbine/HRSG Pair	123,745.3	14.126	1.78
S-9 Fire Pump Diesel Engine (50 firing hours/year)	370.5	0.042	5.29E-03

Table B-14
PM_{10} Emission Rates for Worst-Case Annual-Average Impacts

Source (Operating Mode)	PM_{10}		
	lb/yr	lb/hr	g/s
Gas Turbine (27 hot start-ups)	515.7		
Gas Turbine (9 warm start-ups)	344.25		
Gas Turbine (12 cold start-ups)	765		
Gas Turbine (2,800 hours/turbine @ 1,756.7 MM BTU/hr)	25,200		
Gas Turbine & HRSG (5,260 hours w/duct burner firing @ 2,018.9 MM BTU/hr)	67,065		
Total Emissions for each Gas Turbine/HRSG Pair	93,890	10.72	1.35
11-Cell Cooling Towers (2)	12,264	1.4	0.008[a]
S-9 Fire Pump Diesel Engine (50 firing hours/year)	6.5	7.42E-04	9.34E-05

[a]emission rate per cell (22 total for both cooling towers)

Table B-15
PM_{10} Emission Rates for Worst-Case 24-hour Average Impacts
(February through October)

Source (Operating Mode)	PM_{10}		
	lb/day	lb/hr	g/s
S-1, S-3, S-5, & S-7 Gas Turbines (24 hour operation with duct burner firing @ 2,147.7 MM BTU/hr; 17oF)	306	12.75	1.61
11-Cell Cooling Towers (2)	33.6	1.4	0.008[a]
S-9 Fire Pump Diesel Engine[b]	0.065	0.0027	3.41E-04

[a]emission rate per cell (22 total)

[b]based upon 0.5 hour of full-load operation per 24-hour period

Table B-16
PM_{10} Emission Rates for Worst-Case 24-hour Average Impacts (November through January)

Source (Operating Mode)	PM_{10}		
	lb/day	lb/hr	g/s
S-1, S-3, S-5, & S-7 Gas Turbines (Daily maximum restricted by permit conditon for November through January)	270	11.25	1.417
11-Cell Cooling Towers (2)	33.6	1.4	0.008[a]
S-9 Fire Pump Diesel Engine[b]	0.065	0.0027	3.41E-04

[a]emission rate per cell (22 total)
[b]based upon 0.5 hour of full-load operation per 24-hour period

Table B-17
CO Emission Rates for Worst-Case 8-hour Average Impacts

Source (Operating Mode)	CO		
	lb	lb/hr	g/s
Each Gas Turbine (3-hour warm start-up)	1,180.25		
Each Gas Turbine & HRSG (5 hour operation w/duct burner firing @ 2,147.7 MM BTU/hr; 17°F)	94.5		
Total:	1,274.75	159.34	20.07[b]
S-9 Fire Pump Diesel Engine	0.875[a]	0.109	0.0138

[a]assuming 0.5 hour exercising per day at emission rate of 1.75 lb/hr
[b]applicant calculated and modeled a slightly higher emission rate of 20.840 g/s

Table B-18
NO_2 and CO Emission Rates for Worst-Case 1-hour Average Impacts

Source (Operating Mode)	NO_2		CO	
	lb/hr	g/s	lb/hr	g/s
Two Gas Turbines & HRSGs (start-up mode)	150 (cold start-up)	18.90	663 (warm start-up)	83.528
Two Gas Turbines & HRSGs (100% Load w/Duct Burner Firing @ 17oF; 2,147.7 MM BTU/hr)	15.67	1.974	18.9	2.38
S-9 Fire Pump Diesel Engine	3.705[a]	0.467	0.875[a]	0.109

[a]maximum 0.5 hour exercising per day

B-8.0 Maximum Facility Emissions During Commissioning Period

Table B-21 summarizes the worst-case 1-hour and 8-hour emission rates for the TPP during the commissioning period, when the SCR systems and oxidation catalysts are not yet installed and operational. These emission rates were used as inputs in air quality impact models that were used to determine if the TPP would contribute to an exceedance of the 1-hour State NO_2 ambient air quality standard, the 1-hour State and Federal CO standards, and the 8-hour State and Federal CO standards during the commissioning of the gas turbines, HRSGs, and related equipment. It is assumed that only one gas turbine will be commissioned at one time.

Table B-19
Worst-Case Short-Term NO_2 and CO Emission Rates for Gas Turbines during Commissioning Period

	NO_2		CO	
1-hour Emission Rates	lb/hr	g/s	lb/hr	g/s
Each Gas Turbine	155.5[a]	19.593	95.4[b]	12.02
8-hour Emission Rates[c]				
Each CTG & HRSG Pair	n/a	n/a	165.4	20.84

[a]based upon a conservative exhaust gas NO_x emission concentration of 36 ppmvd @ 15% O_2 for each turbine when operating without abatement by the SCR system; fuel use rate assumed to be approximately 50% of full load, or 844 MM BTU/hr, calculated as follows:

NO_2 = (36 ppmv/2 ppmv)(0.00731 lb NO_2/MM BTU)(844 MM BTU/hr) = 111 lb/hr

[b]based upon turbine exhaust gas CO emission concentration of 20 ppmvd @ 15% O_2 at fuel use rate of 2,147.7 MM BTU/hr, calculated as follows:

CO = (20 ppmv/4 ppmv)(0.0088 lb CO/MM BTU)(2,147.7 MM BTU/hr) = 94.5 lb/hr

[c]based upon one 3-hour warm start-up, followed by 5 hours of 100% load operation of CTG and HRSG at the maximum combined heat input rate of 2,147.7 MM BTU/hr; see Table B-19 for further detail

Appendix C

Emission Offsets

Table C-1 Emission Offset Summary

	NO_x	CO	POC	PM_{10}	SO_2
BAAQMD Calculated New Source Emission Increases[a] (ton/yr)	247.580	335.672	62.620	187.783[b]	29.168
Proposed New Source Annual Emission Limits[c] (ton/yr)	245.390	335.660	58.930	189.51[b]	29.42
Offset Requirement Triggered	Yes	n/a	Yes	Yes	No
Offset Ratio	1.15:1.0[d]	n/a	1.15:1.0[d]	1.0:1.0[e]	n/a
Offsets Required (tons)	**282.199**	**0**	**67.770**	**189.51**	**0**
ERCs identified by Applicant (tons)	**251.396**	**0**	**105.177**	**205.560**	**0**
Outstanding Offset Balance (tons)	**-30.803**[f]	**0**	**+37.408**[f]	**+16.05**	**0**

[a]sum of Gas Turbine (S-1, S-3, S-5, and S-7), HRSG (S-2, S-4, S-6, and S-8) and S-9 Fire Pump Diesel Engine emission increases

[b]does not include emissions from exempt cooling towers

[c]per applicant's emission estimates

[d]pursuant to District Regulation 2-2-302, the applicant must provide emission offsets at a ratio of 1.15 to 1.0 since the proposed facility NO_x and POC emissions from permitted sources will each exceed 50 tons per year

[e]pursuant to District Regulation 2-2-303

[f]pursuant to District Regulation 2-2-302.2, the applicant has opted to provide POC emission offsets to offset the outstanding NOx emission increases

Appendix D

Health Risk Assessment

As a result of the combustion of natural gas at the proposed Gas Turbines and HRSGs and the presence of dissolved solids (heavy metals and other compounds) in the cooling tower water, the proposed Tesla Power Plant will emit the toxic air contaminants summarized in Table 2, "Maximum Facility Toxic Air Contaminant (TAC) Emissions". In accordance with the requirements of CEQA, the BAAQMD Toxic Risk Management Policy, and CAPCOA guidelines, the impact on public health due to the emission of these compounds was assessed utilizing the air pollutant dispersion model ISCST3 and the multi-pathway cancer risk and hazard index model ACE.

The public health impact of the carcinogenic compound emissions is quantified through the increased carcinogenic risk to the maximally exposed individual (MEI) over a 70-year exposure period. A multi-pathway risk assessment was conducted that included both inhalation and noninhalation pathways of exposure, including the mother's milk pathway. Pursuant to the BAAQMD Toxic Risk Management Policy, a project which results in an increased cancer risk to the MEI of less than one in one million over a 70 year exposure period is considered to be not significant and is therefore acceptable.

The public health impact of the noncarcinogenic compound emissions is quantified through the chronic hazard index, which is the ratio of the expected concentration of a compound to the acceptable concentration of the compound. When more than one toxic compound is emitted, the hazard indices of the compounds are summed to give the total hazard index. The acute hazard index quantifies the magnitude of the adverse health affects caused by a brief (no more than 24 hours) exposure to a chemical or group of chemicals. The chronic hazard index quantifies the magnitude of the adverse health affects from prolonged exposure to a chemical caused by the accumulation of the chemical in the human body. The worst-case assumption is made that the exposure occurs over a 70-year period. Per the BAAQMD Toxic Risk Management Policy, a project with a total hazard index of 1.0 or less is considered to be not significant and the resulting impact on public health is deemed acceptable.

In anticipation of pending amendments to District Regulation 2, Rule 1 and Rule 2, a health risk screening was performed to determine the impact of diesel exhaust particulate from the standby fire pump diesel engine. Because the location of maximum impact for the diesel engine does not coincide with the locations of maximum impact for the other sources, the total combined carcinogenic risk for the facility does not exceed 1 in one million. As shown in Table D-1, the increased carcinogenic risk was found to be less than one in one million and is therefore considered to be not significant.

The results of the health risk assessment performed by the applicant and reviewed by the District Toxics Evaluation Section staff are summarized in **Table D-1**.

Table D-1
Health Risk Assessment Results

Source	Multi-pathway Carcinogenic Risk (risk in one million)	Chronic Hazard Index	Acute Hazard Index[a]
Gas Turbines and HRSGs	0.14	0.013	0.467
Fire Pump Diesel Engine	0.8	0.001	--
Exempt Cooling Towers	0.14	0.01	0.039
Maximum Facility Risk:	0.81[b]	0.017	0.472

[a]included for informational purposes only; the BAAQMD TRMP does not require an assessment of the impact due to short-term (< 24 hour) exposure to non-carcinogenic toxic air contaminants

[b]because the location of maximum impact for the diesel engine does not coincide with the locations of maximum impact for the other sources, the carcinogenic risk numbers do not add directly to determine the maximum facility cancer risk shown

In accordance with the BAAQMD Toxic Risk Management Policy (TRMP), the increased carcinogenic risk and chronic hazard index attributed to this project are each considered to be not significant since they are each less than 1.0. The BAAQMD TRMP does not require an assessment of the impact due to short-term (< 24 hour) exposure to non-carcinogenic toxic air contaminants, which is expressed as the acute hazard index.

Based upon the results given in Table D-1, the proposed Tesla Power Project is deemed to be in compliance with the BAAQMD Toxic Risk Management Policy.

Appendix E

SUMMARY OF AIR QUALITY IMPACT ANALYSIS FOR THE TESLA POWER PLANT

May 14, 2002

BACKGROUND

The Tesla Power Plant, LLC has submitted a permit application (#3506) for a proposed 1120-MW combined cycle power plant. The facility is to be composed of four natural gas-fired turbines with heat recovery steam generators, supplemental burners (duct burners), a 22-cell cooling tower, and a diesel fire water pump engine. The proposed project will result in an increase in air pollutant emissions of NO_2, CO, PM_{10} and SO_2 triggering regulatory requirements for an air quality impact analysis.

AIR QUALITY IMPACT ANALYSIS REQUIREMENTS

Requirements for air quality impact analysis are given in the District's New Source Review (NSR) Rule: Regulation 2, Rule 2.

The criteria pollutant annual worst case emission increases for the Project are listed in Table E-1, along with the corresponding significant emission rates for air quality impact analysis.

TABLE E-1
Comparison of Proposed Project's Annual Worst-Case Emissions
to Significant Emission Rates for Air Quality Impact Analysis

Pollutant	Proposed Project's Emissions (tons/year)	Significant Emission Rate (tons/year) (Reg-2-2-304 to 2-2-306)	EPA PSD Significant Emission Rates for major stationary sources (tons/year)	Significant emission rate?
NO_x (as NO_2)	249.85	100	40	yes
CO	484.13	100	100	yes
PM_{10}	196.05	100	15	yes
SO_2	29.55	100	40	no

Table I shows the proposed project emissions and the pollutant significant emission levels for nitrogen oxides (NO_x), carbon monoxide (CO), respirable particulate matter (PM_{10}) and sulfur dioxide (SO_2). The table shows that the NO_2, CO and PM_{10} ambient impacts from the project all exceed the significance level and must be modeled. The detailed requirements for an air quality impact analysis for these pollutants are given in Sections 304, 305 and 306 of the District's NSR Rule and 40 CFR 51.166 of the Code of Federal Regulations.

The District's NSR Rule also contains requirements for certain additional impact analyses associated with air pollutant emissions. An applicant for a permit that requires an air quality impact analysis must also, according to Section 417 of the NSR Rule, provide an analysis of the impact of the source and source-related growth on visibility, soils and vegetation.

AIR QUALITY IMPACT ANALYSIS SUMMARY

The required contents of an air quality impact analysis are specified in Section 414 of Regulation 2 Rule 2. According to subsection 414.1, if the maximum air quality impacts of a new or modified stationary source do not exceed significance levels for air quality impacts, as defined in Section 2-2-233, no further analysis is required. (Consistent with EPA regulations, it is assumed that emission increases will not interfere with the attainment or maintenance of AAQS, or cause an exceedance of a PSD increment if the resulting maximum air quality impacts are less than specified significance levels). If the maximum impact for a particular pollutant is predicted to exceed the significance impact level, a full impact analysis is required involving estimation of background pollutant concentrations and, if applicable, a PSD increment consumption analysis. EPA also requires a Class I increment analysis of any PSD source which increases NO_2 or PM_{10} concentrations by 1 $\mu g/m^3$ or more (24-hour average) in a Class I area.

Air Quality Modeling Methodology

Maximum ambient concentrations of NO_2, CO and PM_{10} were estimated for various plume dispersion scenarios using established modeling procedures. The plume dispersion scenarios addressed include simple terrain impacts (for receptors located below stack height), complex terrain impacts (for receptors located at or above stack height), impacts due to building downwash, and impacts due to inversion breakup fumigation.

Emissions from the turbines will be exhausted from four 200 foot exhaust stacks. Emissions from a 22-cell cooling tower will be released at a height of 55.5 feet. Table II contains the emission rates used in each of the modeling scenarios: turbine commissioning, maximum 1-hour, maximum 8-hour, maximum 24-hour, and maximum annual average. Commissioning is the original startup of the turbines and only occurs during the initial operation of the equipment after installation. The maximum 1-hour takes into account the startup of two turbines, with the other two turbines at maximum load. Different sets of Maximum 24-hour PM_{10} emissions for the turbine/duct burners exist for the periods of February – October and November – January. The applicant proposed, and will be limited by a permit condition to, lower 24-hour average PM_{10} emissions for the winter months of November through January.

The EPA models SCREEN3 and ISCST3 were used in the air quality impacts analysis. A land use analysis showed that the rural dispersion coefficients were required for the analysis. The models were run using three years of meteorological data (1997 through 1999) collected approximately 3.5 km east of the project at the San Joaquin Valley Unified Air Pollution Control District's Tracy Monitoring Station. The Ozone Limiting Method was employed to convert one-hour NO_x impacts into one-hour NO_2 impacts. Hourly ozone monitoring data was also available from the Tracy Monitoring site for the same period (1997-1999). Because the exhaust stacks are less than Good Engineering Practice (GEP) stack height, ambient impacts due to building downwash were evaluated. The Ambient Ratio Methodology (with a default NO_2/NO_x ratio of

0.75) was used for determining the annual-averaged NO_2 concentrations. Because complex terrain was located nearby, complex terrain impacts were considered. Inversion breakup fumigation was evaluated using the SCREEN3 model.

TABLE E-2
Averaging Period Emission Rates used in Modeling Analysis (g/s)

Pollutant Source	Max.[1] (1-hour)	Commissioning [2] (1-hour)	Max. (8-hour)	Max. Feb - Oct (24-hour)	Max. Nov - Jan (24-hour)	Max. Annual Average
NO_x						
Turbine/Duct Burner 1	18.90	19.593	—	—	—	1.797
Turbine/Duct Burner 2	18.90	19.593				1.797
Turbine/Duct Burner 3	1.974	19.593				1.797
Turbine/Duct Burner 4	1.974	19.593				1.797
Fire Water Pump	0.467	—				2.77×10^{-3}
Each Cooling Tower Cell (22 total)	—	—				—
CO						
Turbine/Duct Burner 1	83.538	12.020	20.840	—	—	—
Turbine/Duct Burner 2	83.538	12.020	20.840			
Turbine/Duct Burner 3	3.606	12.020	20.840			
Turbine/Duct Burner 4	3.606	12.020	20.840			
Fire Water Pump	0.110	—	0.0138			
Each Cooling Tower Cell (22 total)	—	—	—			
PM_{10}						
Turbine/Duct Burner 1	—	—	—	1.593	1.417	1.366
Turbine/Duct Burner 2				1.593	1.417	1.366
Turbine/Duct Burner 3				1.593	1.417	1.366
Turbine/Duct Burner 4				1.593	1.417	1.366
Fire Water Pump				3.41×10^{-4}	3.41×10^{-4}	4.86×10^{-5}
Each Cooling Tower Cell (22 total)				7.98×10^{-3}	7.98×10^{-3}	7.98×10^{-3}

[1]Max 1-hour has two turbines in start-up, while the other two turbines are at maximum load. Start-up is the beginning of any of the subsequent duty cycles to bring a turbine from idle status up to power production. [2]Commissioning is the original startup of the turbines and only occurs during the initial operation of the equipment after installation.

Air Quality Modeling Results

The maximum predicted ambient impacts of the various modeling procedures described above are summarized in Table III for the averaging periods for which AAQS and PSD increments have been set. Shown in Figure 1 are the locations of the maximum modeled impacts.

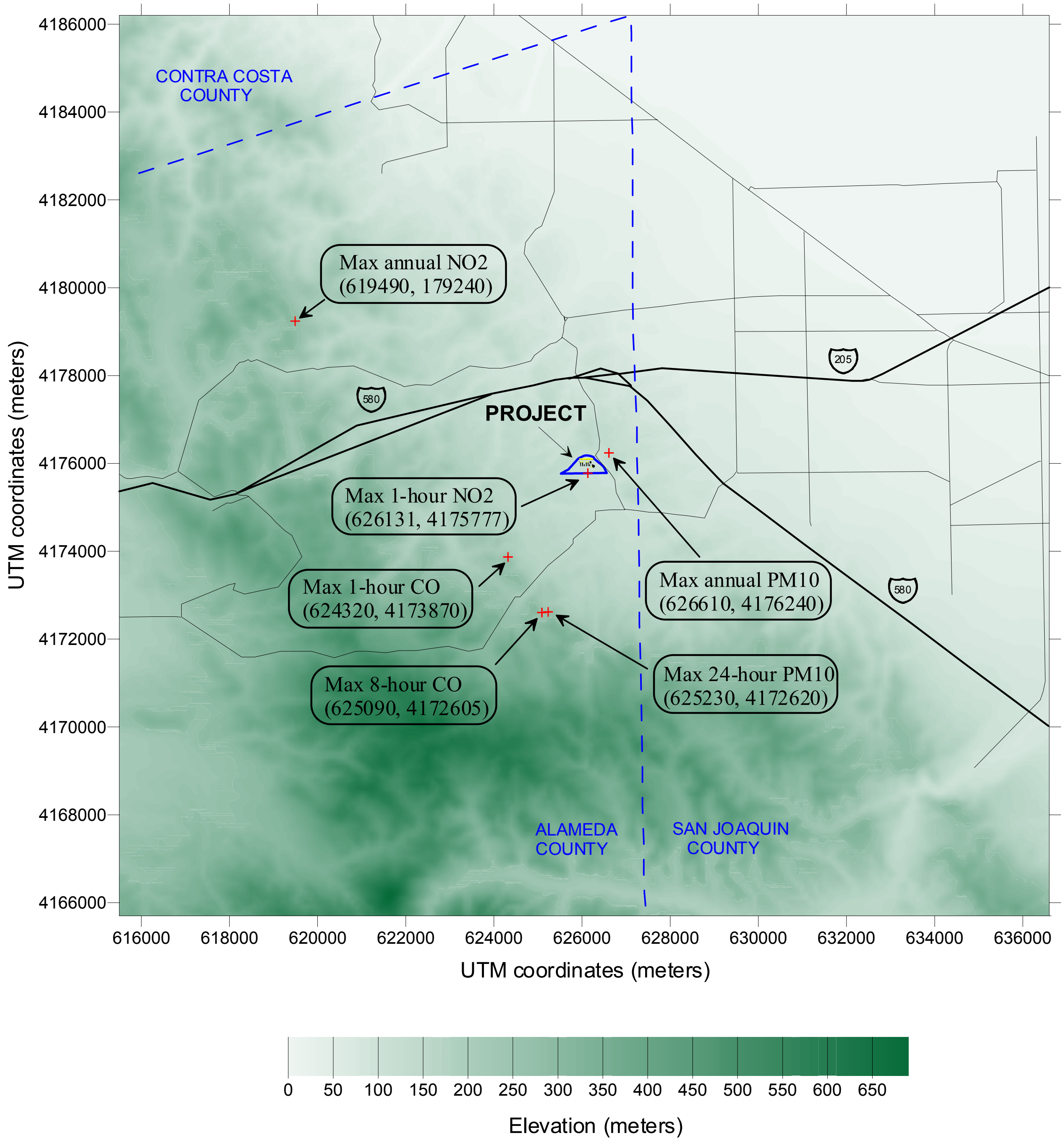

Figure 1. Location of project maximum impacts.

Also shown in Table III are the corresponding significant ambient impact levels listed in Section 233 of the District's NSR Rule. In accordance with Regulation 2-2-414, further analysis is required only for those pollutants for which the modeled impact is above the significant air quality impact level. Table E-3 shows that the only impact requiring further analysis is the 1-hour NO_2 modeled impact.

TABLE E-3
Maximum Predicted Ambient Impacts of Proposed Project ($\mu g/m^3$)
[maximums are in bold type]

Pollutant	Averaging Time	Commissioning Maximum Impact	Inversion Break-up Fumigation Impact	ISCST3 Modeled Impact	Significant Air Quality Impact Level
NO_2	1-hour	165.8	66.2	**187.6**	19
	annual	—	—	**0.23**	1.0
CO	1-hour	375.5	268.9	**1366.8**	2000
	8-hour	—	—	**230.24**	500
PM_{10}	24-hour	—	3.20	**4.97**	5
	annual	—	—	**0.46**	1

Background Air Quality Levels

Regulation 2-2-111 entitled “Exemption, PSD Monitoring,” exempts an applicant from the requirement of monitoring background concentrations in the impact area (section 414.3) provided the impacts from the proposed project are less than specified levels. Table E-4 lists the applicable exemption standard and the maximum impact from the proposed facility. As shown, the modeled NO_2 impact is well below the preconstruction monitoring threshold.

TABLE E-4
PSD Monitoring Exemption Levels and Maximum Impacts
from the Proposed Project for NO_2 ($\mu g/m^3$)

Pollutant	Averaging Time	Exemption Level	Maximum Impacts from Proposed Project
NO_2	annual	14	0.23

The California Air Resources Board-operated Stockton-Hazelton Monitoring Station, located 36.6 km northeast of the project, was chosen as being conservatively representative of the regional background NO_2 concentrations. Table E-5 contains the concentrations measured at the station over the three modeling years (1997 through 1999).

TABLE E-5
Background NO_2 ($\mu g/m^3$) at the Stockton-Hazelton Monitoring Station
for the Modeling Years 1997 - 1999 (maximum is in bold type)

	NO_2
Year	Highest 1-hour average
1997	169
1998	192
1999	**199**

Table E-6 below contains the comparison of the ambient standards with the proposed project impacts added to the maximum background concentrations. The California ambient NO_2 standard is not exceeded from the proposed project.

TABLE E-6
California and National Ambient Air Quality Standards and
Ambient Air Quality Levels from the Proposed Project ($\mu g/m^3$)

Pollutant	Averaging Time	Maximum Background	Maximum project impact	Maximum project impact plus maximum background	California Standard	National Standard
NO_2	1-hour	199	187.6	387	470	---

CLASS I PSD INCREMENT ANALYSIS

EPA requires an increment analysis of any PSD source which increases NO_2 or PM_{10} concentrations by 1 $\mu g/m^3$ or more (24-hour average) inside a Class I area. Point Reyes National Seashore is located roughly 103 km to the west of the project and Pinnacles National Monument is located roughly 136 km south southeast of the project. Table E-7 shows the results of an impact analysis using ISCST3 for the maximum 24-hour NO_2 and PM_{10} impacts within the Class I areas. All impacts were below the 1 $\mu g/m^3$ increments trigger level.

TABLE E-7
Maximum Predicted Ambient Impacts of Proposed Project ($\mu g/m^3$)

Pollutant	Averaging Time	Point Reyes National Seashore	Pinnacles National Monument
NO_2	24-hour	0.62	0.38
PM_{10}	24-hour	0.24	0.14

VISIBILITY, SOILS AND VEGETATION IMPACT ANALYSIS

Visibility impacts were assessed using EPA's VISCREEN visibility screening model. The analysis shows that the proposed project will not cause any impairment of visibility at the Point Reyes National Seashore or at the Pinnacles National Monument.

The project maximum one-hour average NO_2, including background, is 387 $\mu g/m^3$. This concentration is below the California one-hour average NO_2 standard of 470 $\mu g/m^3$. Crop damage from NO_2 requires exposure to concentrations higher than 470 $\mu g/m^3$ for periods longer than one hour.

Maximum project NO_2, CO, SO_2 and PM_{10} concentrations would be less than all of the applicable national primary and secondary ambient air quality standards, which are designed to protect the public welfare form any known or anticipated effects, including plant damage. Therefore, the facility's impact on soils and vegetation would be insignificant.

CONCLUSIONS

The results of the air quality impact analysis indicate that the proposed project would not interfere with the attainment or maintenance of applicable AAQS for NO_2, CO and PM_{10}. The analysis was based on EPA approved models and calculation procedures and was performed in accordance with Section 414 of the District's NSR Rule.

Appendix F

BACT Cost-Effectiveness Analysis Data